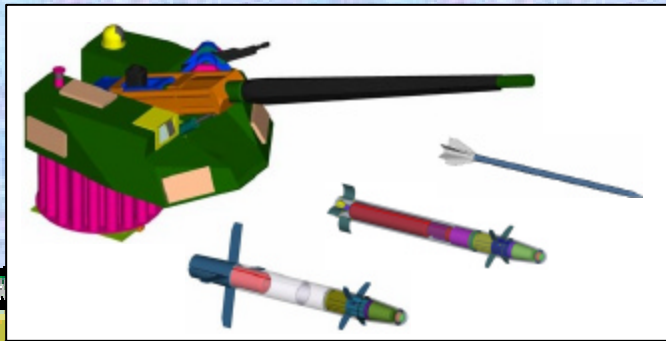




FCS Multi-Role Armament and Ammunition ATD



Presented by:

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Technical Director**



Committed to Excellence

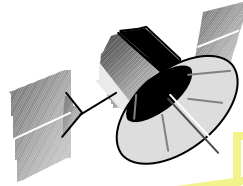


Future Combat Systems Enabling the Objective Force

**Indirect Fire
Function***



**Direct Fire
Function ***



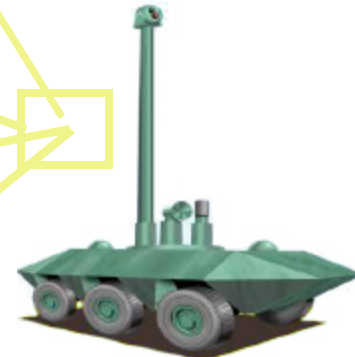
**Organic &
inorganic
RSTA**



**Networked
Command,
Control &
Comms**



Infantry Carrier Function



**Sensor
Function***

** Manned or
unmanned*

**Multi-Role Armament System is One Platform
that provides Direct and Indirect capabilities**





FCS Multi-Role Armament & Ammunition ATD (III.WP.1999.01)



Objective: Demonstrate an integrated multi-role armament system providing lethality overmatch capability in the expanded "**Red Zone**" Close Fight and Tactical Deep Fight, enabling the Objective Force to dominate maneuver throughout the Full Spectrum of Conflict.



*"One Shot..
....At Least One Kill"*

NLOS 4-50KM

*"Multipurpose/Precision Point
Target Defeat"*

BLOS 2-12km

Pacing Technologies:

Cannon -

- Electrothermal-Chemical propulsion
- Recoil mitigation

Munition -

- Seeker/G&C
- Multi-Mode Warhead

W

- Reduced logistics footprint – through common armament module and single cartridge envelope

One Lightweight Armament System Capable of Dominating the Red Zone and Beyond



Lethality Approach

– LOS

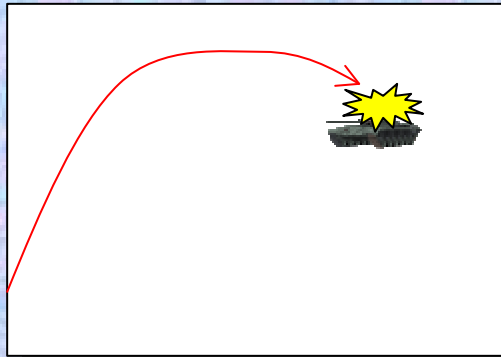
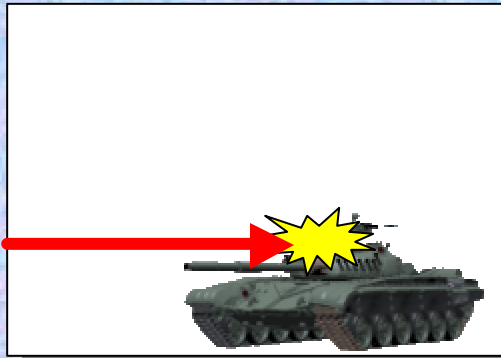
Robust Simplicity...

- Quick, robust defeat of heavy armor in a smaller, lighter package.
- Fight and survive w/o perfect situational understanding
- Lethal right out of tube – no deadspace
- Inherent accuracy from tube. No slow launch tip off problems. No guide through boost.

– BLOS & NLOS

State-of-the art sophistication...

- Precision munitions to extend lethal reach beyond effective standoff of enemy – improved survivability



Coupling of robust simplicity and state-of-the-art sophistication provides inherent versatility and agility.



Integration Approach

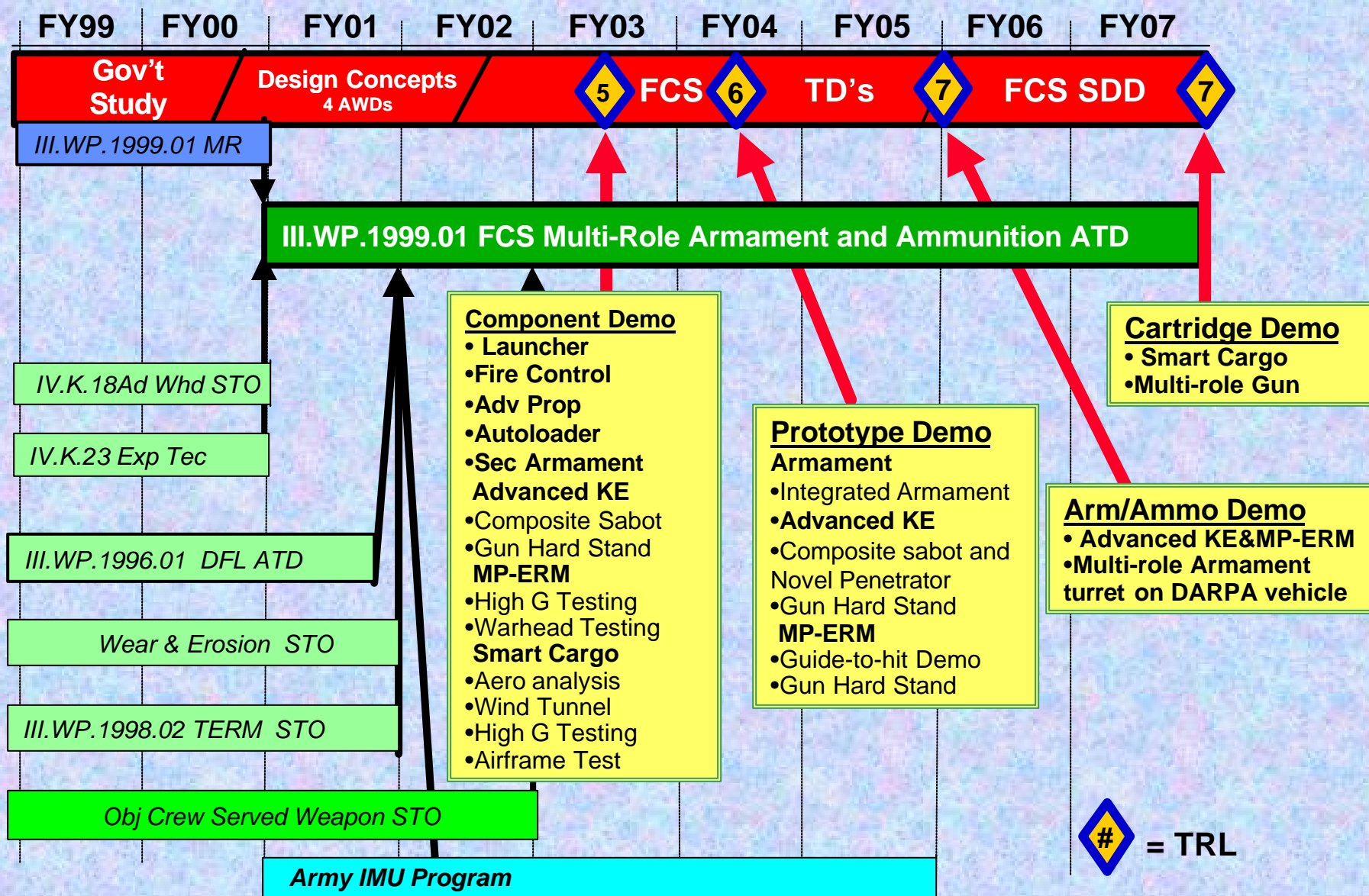
- **Lightweight, low and high elevation gun**
- **Recoil Migration**
- **Advanced Propulsion**
 - **Electro-Thermal-Chemical Ignition**
 - **High Energy, Low Vulnerability Propellants**
- **Ammunition Development**
 - **BLOS-NLOS Precision Munitions**
 - **Novel, Multi-Purpose Warheads**
 - **LOS Advanced KE**
- **Compact Ammo Storage**
- **Advanced Fire Control**
 - **Compatible w/ real-time sensor to shooter links**



A Synergistic Approach will provide Revolutionary Firepower



FCS Multi-Role - Roadmap





Subsystems Challenge

- Main Armaments



- Recoil management

- High recoil forces and light vehicles present unique challenges while minimizing recoil stroke.

- Launcher with swing chamber

- Compact ammo handling needed to allow more room for stowed ammo

- Fire Control

- Direct and indirect compatible with network centric force.

Ammo Suite

- High single shot probability of kill

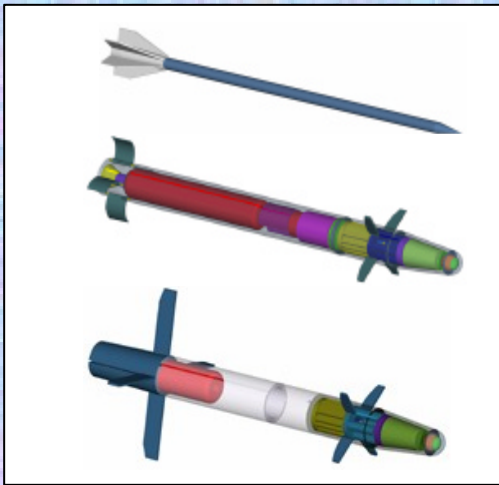
- Maximize number of stowed kills
 - Minimize time of flight

- Multi-Mode Warhead Development

- effects against multiple targets with one munition type

- Electro-thermal-chemical (ETC) Propulsion

- High energy propellant with low sensitivity and precision ignition





Electro Thermal Chemical (ETC) Propulsion

Solution

–Electro-Thermal-Chemical (ETC) propulsion

- Electric energy converted to high temperature plasma which results in repeatable ignition of high energy, low vulnerability propellant.

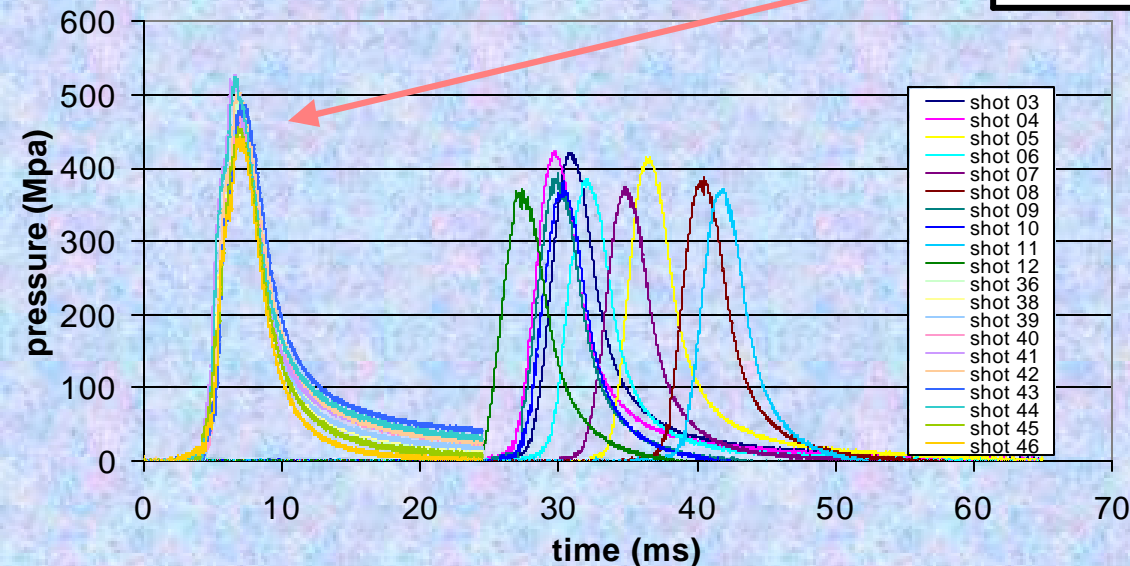
–GEN II Propellant

- New formulation
 - 13% increase in energy per gram
 - 50% increase in loading density

–Tactically Sized PFN

- Today: 1m³; Goal: 0.25m³

Ignition Type	Conventional	ETC
Number of shots	10	10
Velocity (average)	1192 m/s	1209 m/s
T2 Time (average)	31.4 ms	4.66 ms
T2 Sigma	4.85 ms	0.150 ms



Accomplishments

- 20 % increase** in muzzle performance
- Precision Ignition demonstrated on 105mm test fixture (JAN 01)
- GEN II characterization studies initiated (JAN 01)
- ETC firings with 105mm FOOB Gun complete (MAR 01)

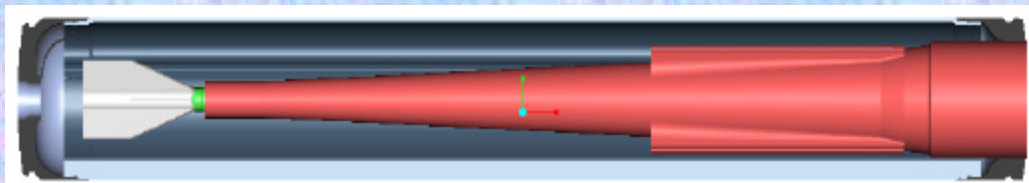


Advanced KE

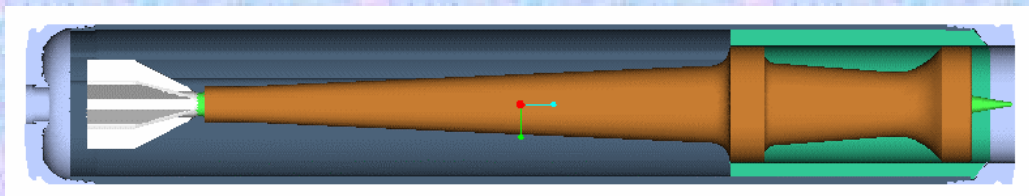
Solution

–Advanced KE projectile

- ETC (Higher muzzle energy)
- Composite Sabot
 - Lighter sabot puts more energy into rod
 - Goal: 55% reduction of sabot mass versus aluminum (e.g., fielded, 105mm, M900 KE projectile)
- Novel Penetrator



KE Puller Sabot Configuration



KE (conventional) Pusher Sabot Configuration

Accomplishments

- Engineering design and analysis of puller and pusher composite sabot
- Teamed with industry to support IR&D 105mm composite sabot work
- Fabrication of projectile hardware
- Ballistically tested first 105mm CTA cartridge (April 01)



Smart Suite (MP-ERM and Smart Cargo)

MP ERM Solution

- Precision munition
 - Hi-G survivable G&C
- Multi-purpose warhead
 - More powerful explosives
 - Ignition circuits / selectable fuzing

Smart Cargo Solution

- Lightweight Accurate Carrier Round
 - Maximize payload volume
 - smart skin (smart materials/structures for control actuation surfaces)
 - Metal matrix composites for airframe
- Hi-G survivability of navigation sensor and airframe
- Dynamic Retargeting



Accomplishments

- Combined IPT teams into Smart Suite IPT
- Projectile design and aeroballistic study
- Smart Suite Industry day held – 4 Contracts Awarded
- Followed Captive Flight Tests of TERM and XM982

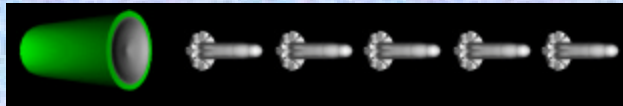


Multimode Warhead Modes

Solution

- High energy explosive formulations with selectable initiation while maintaining sensitivity
- Multi-purpose compact SC and/or multi-purpose high performance aerostable EFP warheads

Mode 1: Main Battle Tanks (MBT)



Accomplishments

Shape Charge

- Increased performance **17%** while reducing warhead size **25%**.
- Completed Multi-purpose designs.

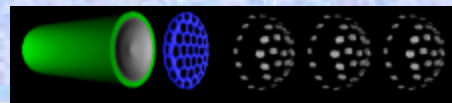
EFP

- Increased Performance **25% in same size**
- Completed manufacturing and interface of Collinear EFP designs

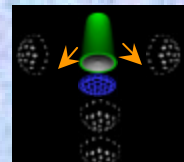
Mode 2: Armored Personnel Carriers



Mode 3: Helicopters



Mode 4: Anti-personnel

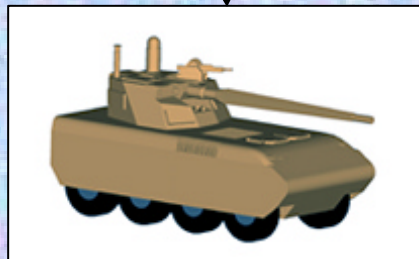




Multi-Role Fits Chassis Designs



FSCS



RAVE



**FCS DARPA
Primes**



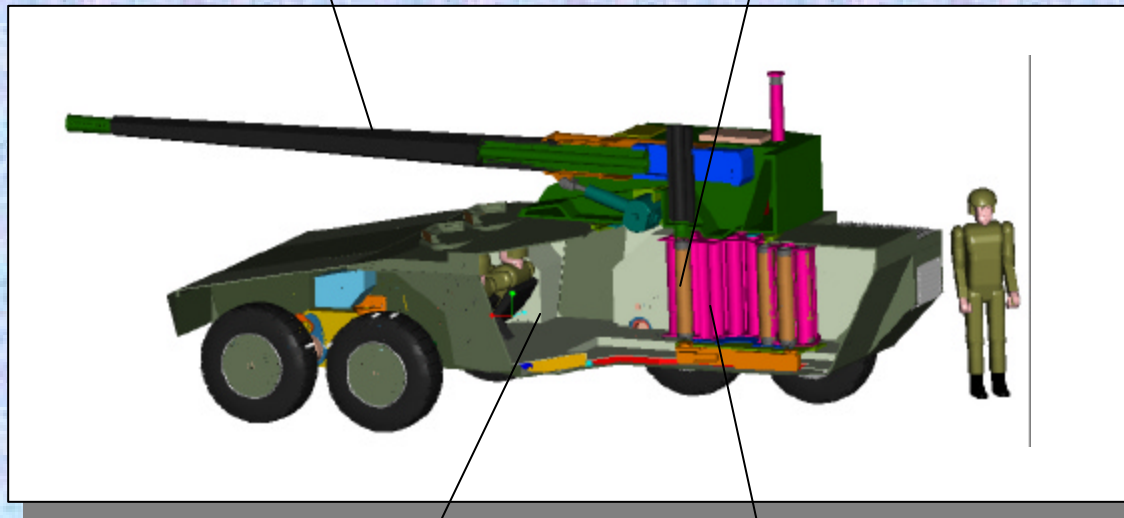
- TACOM establishing interface requirements w/ DARPA Primes
 - Vehicle Integration
 - C4ISR Integration



Vehicle Vulnerability Considerations

Extended range lethality

Low vulnerability propellant



Crew Compartmentalization

Composites for Blast Mitigation

**Armament design is critical to enhance crew survivability
on light weight platform**

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Summary

- **Pacing technologies have been identified & on schedule TRL 7 by FY05**
 - Advanced Propulsion - ETC
 - Recoil Mitigation - FOOB
 - Munitions – seeker and G&C
 - Multi-Mode warhead
- **LOS , BLOS & NLOS fires organic to same launcher**
 - Multi-Mission Capability in One Vehicle
- **Robustness to fight & survive w/o perfect situational understanding.**
 - Rapidly reacts to leakers or surprises.
- **Enhanced crew survivability via under armor ammo storage.**
- **50 multifunctional munitions stowed**

Full spectrum lethality from a single lightweight gun for superior versatility, agility, and survivability.



Multi-Role Fire Control

Technical (Platform) Solution

- Dynamic muzzle (not Trunnion) stabilization
- Automatic muzzle reference sensing
 - Compensates for boresight drift
- Improved meteorological (MET) sensing

Tactical (Networked) Solution

- Multi-agent fire control
 - Distributed Interactive Fire Mission (DIFM)
 - Maximize first round probability of hit FCS
- Combat Decision Aids
 - Ensure proper tactical decision making using all available info

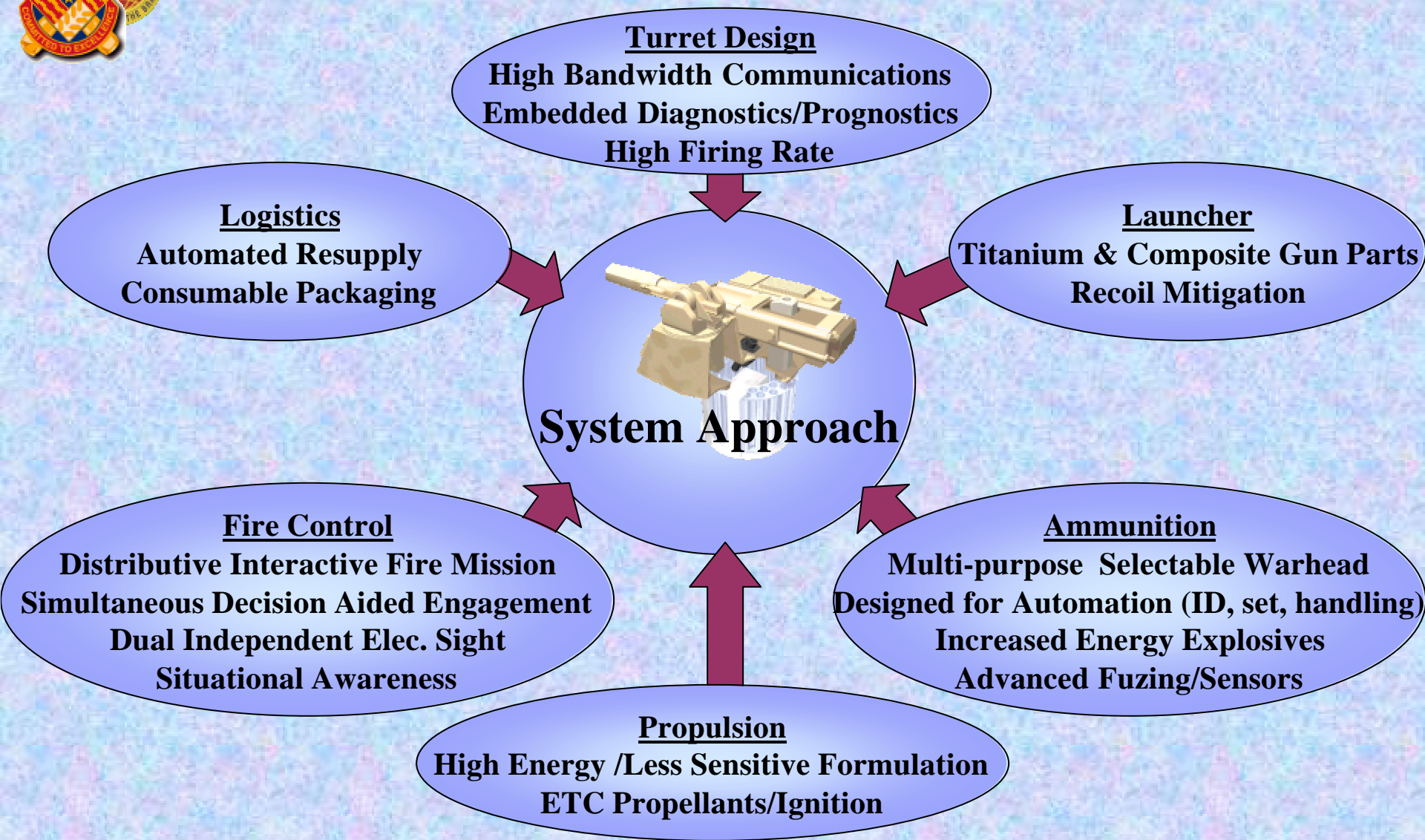
Accomplishments

- Awarded contracts for decision aids development and DIFM algorithms
- Fire Control Prime solicitation combined with Turret Integration solicitation
- Teaming arrangements in process with with CECOM and AMRDEC for Network Centric Fire Control and Comm.
- Teaming arrangements in place with TARDEC for vehicle electronics





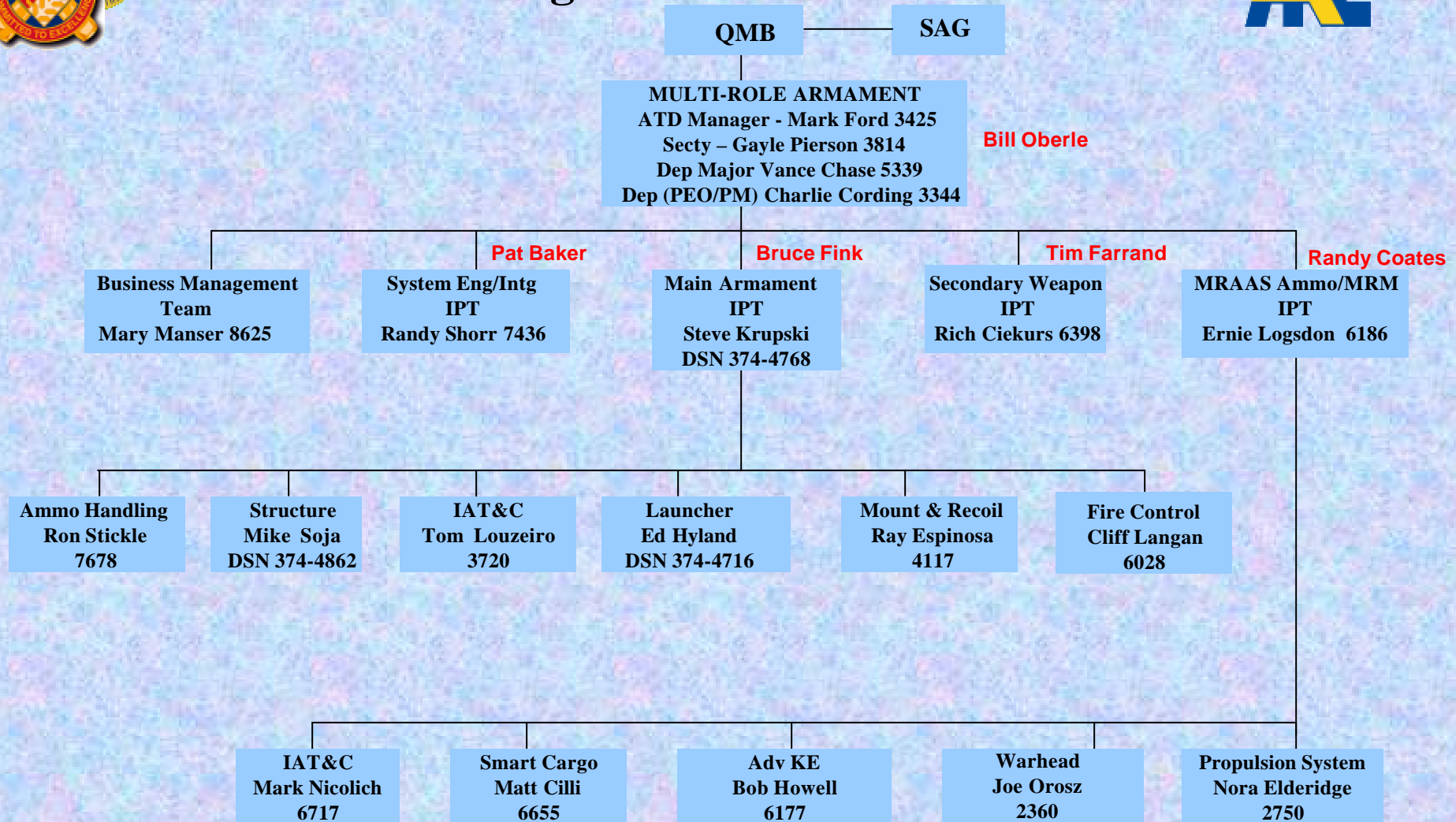
Synergistic Approach to Armaments



Teaming with Industry and OGA Critical for Success



Multi Role Armament/Ammunition Organization Structure



All phone numbers
Are 973-724- or DSN 880
Unless noted.

ARL Leads in red



FCS Multi-Role Armament and Ammunition Summary

Summary:

- **ATD meets the Army Transformation Vision**
- **Pacing technologies have been identified**
 - **Demonstrated via live fire test and analysis.**
- **Exit Criteria verified by test activities**
- **Working with DARPA & DARPA Primes**
- **Significant User support**

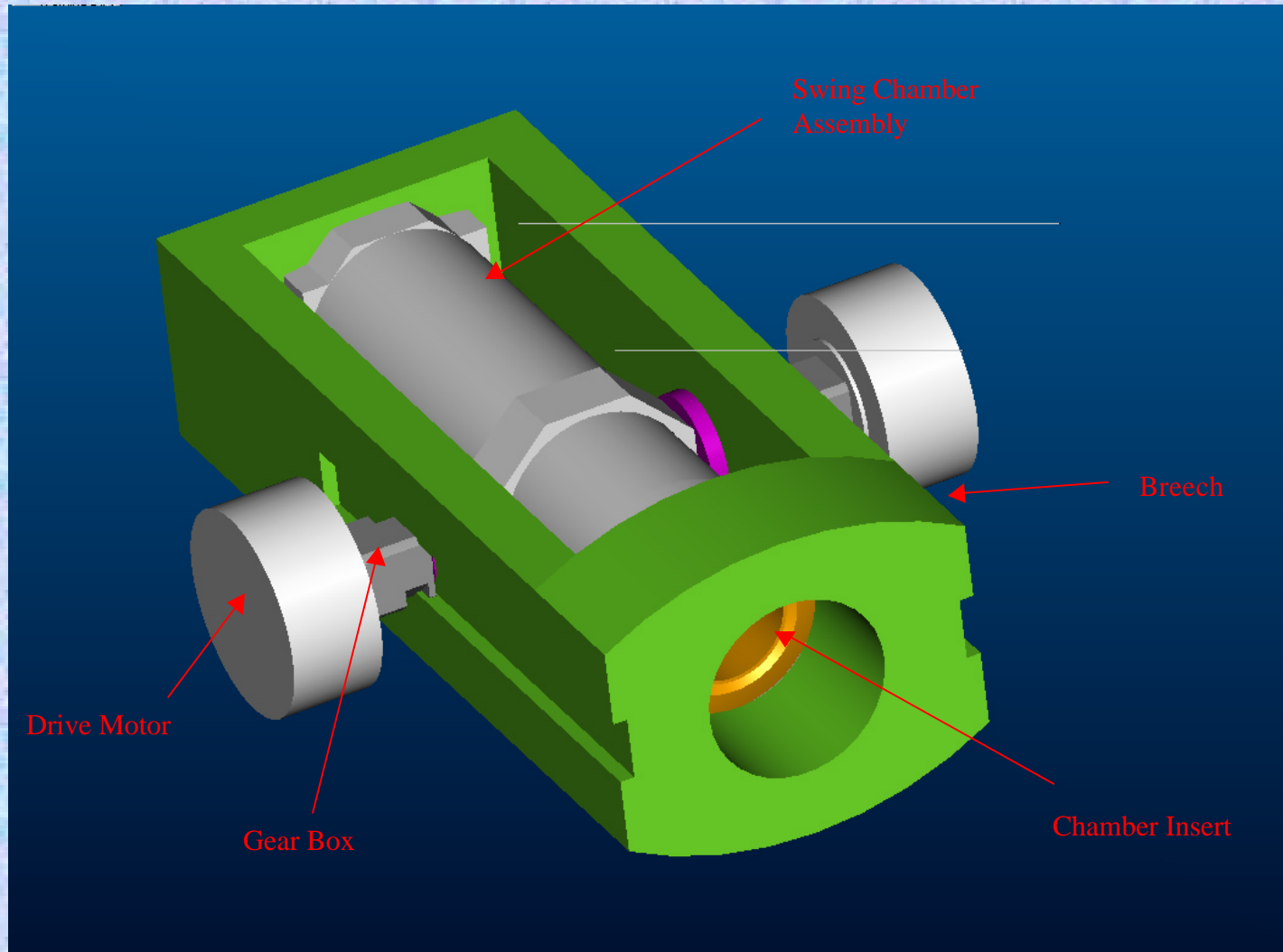


One Lethality Approach...

A Lightweight Armament System to Dominate Red Zone & Beyond



Swing Chamber Cannon



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